REPORT ON THE TIN MINES AT THE BLUE TIER,

COUNTY OF DORSET.

Sir,

I have the honour to report to you on the state of the tin-mining industry in the Blue Tier district as seen during my recent visit in October last. There has not been very much progress since I previously visited the field in October, 1889, and in some respects there is not a great deal to add to my report of 5th November, 1889. On this occasion, however, I visited several properties which have been opened up since my former visit, and I have now to describe these, besides noting the progress made on those previously seen.

The granite of which the Blue Tier Range is composed is quite similar to that found in all the other tin districts of North-eastern Tasmania, the Mount Cameron, Ben Lomond, Freycinet Peninsula, and St. Paul's River granites being indistinguichable from it. It is a somewhat coarse-grained grey, or occasionally pin-coloured, porphyritie granite, the porphyritic crystals of felspar being often from half an inch to over an inch in length. Small quartz veins carrying tinstone are pretty common through it, and there is reason to believe that much of the alluvial tin which has been so plentifully found in the district is derived from these, and not from large lodes as is usually assumed.

Through the main country granite run a number of dykes of another sort of granite which often is richly impregnated with tin-ore. As pointed out in my former report this varies so much is composition that it is hard to find a satisfactory name for it: it is as a rule much finer grained than the main granite, and there is no porphyritic crystals of felspar. In some places it is a fairly typical quartz-porphyry, but in others it becomes greisen and haplite. It is generally much decomposed near surface by the action of atmospheric influences, the felspar being converted into kaplin, and mica into talc and clayey matter. On the whole I still think that quartz-porphyry is the most appropriate name to be given to this rock, though certainly parts of it vary very far from the typical composition. The dykes of quartz-porphyry are distributed irregularly through the district, but there appear to be two main masses ot it, one north of Foimena township, of which Mr. Macmichael must be about the centre, the other in the Anchor and West Anchor Companies' properties and westward from these. A detailed survey would be required in order to lay down the position of these dykes accurately on a map; and in the existing state of much of the ground, still covered with dense forest growth, this would be a tedious and expensive work, but their general position and probable relation to each other are shown in the sketch diagram attached to this report.

In regarding these bodies of stanniferous granite as dykes, I regret to find that I am not in accord with the high authority of Professor G.H.F. Uirich, who views them as stockworks in his report on the Cream Creek mine. The Cream Creek stanniferous rock is the same as is found in the Anchor, Liberator, New Moon, Puzzle, and other mines on the Blue Tier, and if the former is called a stockwork

the latter should be so named. Professor Ulrich's remarks are well worth quoting: he says "First, as regards the character of the tin-bearing deposit in a mining geology point of view, I must at once say that I do not agree with the views that I have heard advanced in this respect. The deposit is in my opinion neither a lode, intrusive dyke, nor superficial tin-bearing cap of granite, but belongs to the class of deposits called 'stockworks', of which examples exist and have been worked for ages in Saxony, Bohemia, and Cornwall, in which latter country they are usually called tin floors. They may be regarded as mineralised zones or bodies of the country rock, i.e. granite, which in longitudinal extent and depth have no defined boundaries, whilst laterally such boundaries do exist in some cases, in others they are likewise absent. The granite of these bodies is nearly always different in character from the prevailing country rock, i.e. more dense or fine-grained, more felspathic or quartzese, or again more micaceous, with mica of a different colour from that of the country rock; and as regard the tin ore, it occurs in it in various ways, such as impregnated through out the rock from very poor to very rich in places, and from the finest grains, hardly visible to the naked eye, so particles above a hazelnut in size; in fine veins and seems traversing the rock in all directions; in larger patches, often showing fine crystals in drusy cavitiss, veins, or little lodes of quartz, felstone, and greison (quartz and mica), always, and often richly, tin-bearing are rarely (if ever) absent, traversing the tin granite. How, as already intimated, all these special features gradually disappear in longitudinal extent and depth, and there is a gradual transformation into the common barren granite, whilst in lateral extent there may be either a sudden change or also a gradual transition. As an evident consequence of this change the stockwork becomes, of course, ultimately too poor for working. This description refers to stockworks in general, but from what I have noticed the Cream Creek deposit, as regards mineral conforms to it in all essential particulars.

The Blue Tier stanniferous granites agree very closely with the above description; but it seems to me that their mode of occurrence, as shown in the sketch diagram, is that of intrusive dykes. Nowhere in the district have I seen any gradual transition from the quartz-porphyry into the surrounding granite, the line of determination between them being always distinct. The altered granite, too, in the neighbourhood of the tin-bearing veins in the main country rock is not in the least like the material of the dykes or stockworks. In one of the cuttings of the Anchor mine the junction of the two sorts of granite is exposed, and have we see quartz veins in the main granite running from the quartz-porphyry, and the former rock appears to have been shattered by the latter; the appearance certainly pointing to the conclusion that the stanniferous rock has been intruded through the porphyritic granite. In some of the workings of the New Moon mine, where the junction of the two rocks is exposed, it seems pretty clear that they are of different ages, and the shape of the deposit in this place, running as it does in a long narrow belt through the main granite, is that characteristic of a dyke. Another reason for regarding these masses as dykes is that, in parts, they are composed of hard dense quartz-porphyry of typical character, containing little or no tin ore, and presenting none of the alteration of the constituent minerals which is

so general and feature in the more stanniferous portions. This sort of quartz-porphyry is well seen in the deep cutting at "The Falls", at the outlet from the tail-race from the New Moon battery. My reading of the district therefore is, that there have been intrusive dykes of quartz-porphyry forced through the older country granite, and that these have subsequently undergone a great deal of chemical ulteration, which has resulted in the separation of tin ore in fine crystals through out their mass. The difference between Professor Uirich's view and my own really is that, while he considers the stanniferous masses to be a portion of the main granite, which has been modified by chemical a portion of the main granite, which has been modified by chemical alteration, I think that they are later dykes through it which have undergone a similar chemical change. There is this important difference between these conceptions: that if the former is correct, the depth of the tin-bearing deposits is comparatively limited in all probability, while, in the latter case, the ore is likely to occur in the dykes to a great depth. This question of the downward extension of the stanniferous rock in depth is of very great importance to the district, and boring with diamond drills should be resorted to settle it. I shall have more to say on this head later on.

In all the stanniferous dykes on the Blue Tier the tin ore appears to be segregated into certain patches, often of a considerable extent, which gradually becomes poorer towards their outskirts, and finally pass into almost barren quartz-porphyry. These patches of richer rock might, perhaps, be termed stockworks, and the mode of occurrence of the tin ore might then be said to be as stockworks in dykes of quartz-porphyry. I prefer, however, to use the less restricted term "impregnation", which signifies that the ore is scattered irregularly through the mass of rock containing it.

During this second examination of the Blue Tier district I found the quartz-porphyry to be much more widely distributed than I had noticed it on my previous visit, and it does not appear to be so generally tin-bearing as I than imagined, large quantities of it appearing to be very barren. Where it is hard and dense, and consists of granules of quartz set in a felsitic matrix, it seems to be always poor, but when the mica and felspar are distinguishable and the rock is softer, more tin ore is found in it. The micaceous varieties appear to be rather more favourable for tin than the others, though I have seen rich specimens of Haplite (quartz and felspar) containing no mica. Both the mica and the felspar, in the stanniferous portions generally, appear to have undergone much chemical alteration, even in the deeper parts where they have not been altered by atmospheric action, and the possibility suggests itself that the tin was originally in the rock, in combination with other bases, as a silicate, and that it has been set free as oxide much in the same way as magnetite in serpentinous rocks, which is eliminated from a state of previous combination during the chemical change from olivine to serpentine. This, however, is only a suggestion.

I shall now proceed to describe the various properties visited on this occasion. As most of these have more or less

alluvial tin upon them, in addition to the more permanent deposits in the shape of lodes and stanniferous dykes, it will be easier to describe each by itself without attempting to group together all those on which there are alluvial working, all those which possess true lodes, and those which are on stanniferous dykes. Several of the properties have all three modes of occurrence of the tin ore.

Lottah, Wellington, and Giant Mines.---No work having been done on these leases since my former visit, I did not examine them again on this occasion. It is a great pity to see such a promising mine as the Lottah lying idle, especially as it has been opened up all ready to begin stoping, and so prove quickly if the mine is payable. Judging from the ore taken from the drives I think it ought to be. For a full account of this and the other two mines above named I must refer to my former report.

New Moon Mine.---This property was formerly called the Full Moon mine, but has been renamed. It is owned by the New Moon Tin Mining Company, No Liability, which also now holds the ground spoken of in my former report as Haley's Lease (sections 907 and 908). These have since been made over to the M'Gough Tin Mining Company, No Liability, which later on was omalgamated with the New Moon Company. The latter now holds sections 1263M, 184-87M, 967M, 966M, 1683M, 907, and 908, inall 322 acres. In the old Full Moon part of the ground not very much work has been done since my former report, and the description therein given of the lodes and alluvial workings does not now require any addition. At the time of my previous visit a battery was just getting ready to start crushing the stanniferous quartz-porphyry, and this was described in my report. After working for about six months the owners found they could not make a profit on account of the smallness of the mill and the expense of raising stone to it, and abandoned operations. I have not been able to get complete figures on the quantity of stone crushed and tin ore saved, but, in answer to my inquiries, Mr. Stackhouse, manager of the Full Moon Company, was good enough to give me the following particulars:--"I find that from the 1st February, 1890 , to 19th July, 1890, we crushed 2088 tons of tinstone, which yielded 26 tons of black tin ore, the average assay of which was 62 per cent. the value of it would be about £1500. We get on the average about 35 bags tin ore for a fortnight from, say 165 tons of tinstone: this would be valued at, say £87, and our expenses for the fortnight would come to about the same amount, so that I find there was no profit". The yield for the period stated is equivalent to nearly eight-tenths of one per cent. of metallic tin, and the value of each ton of rock milled is 14s. 4d. Some stone was rejected and not put through the battery, but not very much, and from what I could see of the workings there should be no great difficulty in getting plenty more stone of the same quality as that stamped, and this, if crushed in a large battery, ought to yield a profit. Work was suspended, it should be observed, because it was not profitable with the appliances possessed by the owners, not on account of any lack of crushing stuff. The stanniferous porphyry has now been proved by cuttings made into it to extend over a block of ground quite four chains long by 2½ chains wide, and tin ore is freely visible over this area, not evenly, but still more or less all

over. Many of the patches of ore are very good, and I should think that the stone milled by the Full Moon Company might be regarded as a fair sample of the whole mass. It was not taken from one part only but from several excavations, and should therefore be fairly representative. The quartz-porphyry is exposed in the lower parts of a flat valley lying below the battery, but appears to extend into the hills on each side, and when further prospected it may prove to be easier to get the ore from open quarries in these. The raising of the stone from the workings to the battery was a constant expense to the Full Moon Company, and had a good deal to do with its failure. All the country immediately round the deposit of tin, however, is either higher than it, or slopes so gently away from it, that it would be difficult to get a site for a battery anywhere within reasonable distance. The stone has either to be hoisted to a battery site above the workings, as has been done, or else carried about 70 chains to below "The Falls" on the Wyniford River. A good battery site is obtainable at this latter spot, and has the advantage that it would be considerably below the large conservation dams, which, as pointed out in my previous report, could be, at small cost, constructed on the Sun ahd Wheal Tasman Flats, and close to the township. The dam at the township would be about 70 feet above the Wyniford River at the battery site, but there would not be very much pressure obtainable from the Wheal Tasman dam. I doubt very much if water-power sufficient to drive a large battery of, say 60 heads of stamps could be obtained, and unless this was the case there would be no advantage in having the mill so far away from the mine. It should not be forgotten in dealing with this question that a battery capable of crushing 1000 tons a week would in less than two years use up all the rock now exposed above the level of the tail-race, and that below this level both stone and water would have to be lifted. Under these circumstances, the only alternative to a plant driven by steam-power lie in the adoption of a scheme for bringing in power from a distance by means of electricity, which is quite feasible, or else in making a long and deep adit from the Lottah ground, on the other side of the Blue Tier range, of which I shall have more to say hereafter.

The New Moon Company on acquiring this property began to erect a 30-stamp battery, but owing to the failure of the Bank of Van Dieman's Land this was never finished. The property is, I believe, a good one, and with a large crushing-plant, not less than 50 stamps, capable of paying dividends; but, like all the other Blue Tier stanniferous dykes, the one now under consideration has not been proved to any depth, and before erecting a large mill this ought to be done, so that there should be no doubt as to there being applies for it for many years of work. I know of no way in which this testing could be more cheaply and thoroughly done than by means of a diamond drill. With this madhine it would be a simple matter to sink series of holes all over the tin deposit to any depth that might be thought necessary. If a reasonable number of holes were bored, and the cores carefully crushed and assayed as work went on, it would be possible to estimate with substantial accuracy the value of the rock to the depth of the borings, and it would be a question then for engineering skill to decide if it would be possible to mine and mill the material at a profit. The preliminary expense of testing the ground by boring would be considerable, but I am convinced that it is the proper way to begin working these large low-grade deposits. The only way in which they can by any possibility be made to pay is by working them on an extensive scale, and before putting up the expensive machinery required for this, it is surely a business necessity to

make certain that there will be enough ore to keep it in work. Boring would be preferable to shaft-sinking as a means of testing the deposit, as by its means numerous deep boxes could be made all over a block of ground for the same cost as one shaft; and it is clear that the greater the number of places from which samples of the rock are taken the greater is the certainty that their average yield will truly represent the value of the entire mass.

In the portion of the New Moon property formerly belonging to the M'Gough T.M. Company work has been more vigorously carried on. A battery has been built near the north-west corner of Section 907, on a small stream which runs down to join the larger creek passing through the Blue Tier T.M. Company's ground. The plant consists of 15 heads of stampers and the 5 ft. Huntingdon Mill was formerly in the Full Moon battery; 2 stone-breakers one for the Huntingdon mill, the other for the stamp battery, and II Prue Vanners, one of which is kept for finally dressing the headings from the others. A 40 h.p. engine drives the crushing-plant, and there is a separate small engine for the Vanners. The crushed stuff flows from the stamps and Huntingdon mill through launders to the Prue Vannors without any classification, which, in my opinion, is a mistake, as it is impossible to treat sands and slimes satisfactorily on the same concentrator simultaneously. The Prue Vannera does does wonders in its attempt to do so, but makes better work when dealing with classified stuff; and, as the spitalutten classifiers are cheap, simple, and automatic in their working, there is no reason why they should not be used, and so allow the tables to be worked to the best advantage,....some creating sands alone, and others set at a flatter slope devoted to the slimes. I observed two spitzlutter at the battery, but one had not been used, and the other was simply separating out any heavy sand remaining in the surplus water from the battery which had passed the feeding shoots of the vanners.

Mr. Henry Simpson, manager of the company, has been good enough to give me the following information as to working results and casts:-- "I have taken a period from May 7th to November 11th as affording perhaps the best example. During that time 5037 tons of stone or tin dirt were crushed and concentrated. The cost of mining and delivery to battery was 2s. 3d. per ton: crushing and concentrating 4s. 3d. per ton: all other costs, including freight and management, 4d, per ton. This 5037 tons of stuff yielded 32 tons 13 cwts. 1 gr. 23 lbs. of tin, for which we received £1643 not. The highest assay was 73 per cent, and the lowest 65.8 per cent.; the average of 13 assays equals 69 per cent. approximately. These operations resulted in the ultimate loss of £77 15s. 9d. You will please understand that this is an approximate statement, but must be very nearly correct".

During the six months covered by Mr. Simpson's statement the Huntingdon mill was only at work for perhaps one month, and owing to want of boiler capacity was not working well during the most of that time, so the figures represent the performance of the 15 heads of stamps in 24 hours. The stone yielded .6486 per cent. of black tin, and had a value per ton of 6s. 6½d. All expenses amounted to 6s. 10d. per ton of rock treated, leaving a loss of 3¾d. per ton. I look upon this result as highly encouraging, seeing that it is the performance of only a small mill. The costs are less than half on those at the Full Moon battery quoted above, and would have left a good margin if the stone had been equally rich. With a battery four times as large as

the present one, and better facilities for mining the ore and sending it to the mill, I think that stone containing only one half per cent of black tin will yet be made to pay all expenses and a little profit. Want of capital has prevented the Company from increasing their milling power and saving expenses both in the mine and in the battery. For instance, at the time of my visit great trouble was being experienced in keeping steam up in the boilers on account of the miserably wet green wood that had to be used as fuel. The myrtle wood in a green state contains a great deal of moisture, and what was being used had only been felled a few days. Owing to the state of the company's finances they were not able to keep a stock of dry wood on hand,and had to use it as it came in. Dried myrtle wood is a very fair fuel, and if a good stock of it were kept on hand there would be no trouble in getting enough steam. There are other makeshifts in connection with the working very much on a par with the above, and only requiring a little capital to be put right with consequent economy in working. In the mine the want of money is felt as severly as in the mill, and mining costs would be considerably reduced if it were better opened up. A tramway runs from the battery hoppers to the north of the adit mentioned in my 1889 report. This tunnel has been driven south along the dyke, and the stone above it is being sent down into it through hoppers. Several faces have been opened up, the deepest being 36 feet from the tunnel to surface: practically all the stone has gone through the battery. The stuff varies very much in value, but the good and poor stone are in so intermixed that sorting is not possible to any extent. A face that is very poor one day often shows good stone after a few blasts have been fired in it, and vice versa. If more faces were at work, however, it would be easier to keep the work of the mill uniform. The tunnel ought to be pushed ahead of the working faces, so as to open up new ground and provide fresh places from which good stone could be got to make deficiencies in the older one. Several patches of good stones are known on surface south of the present workings: and the rich vein formerly worked by tributaries as deep as they could go for water, with very good results, is also ahead of them. Instead of extending the present tunnel, however, it would probably be better to start a new one about 25 feet lower. To geth this it would be necessary to cut a tall-race up the creek beside the battery, and drive some little distance through barren granite to the dyke, in order to get drainage for the workings. This lower tunnel would be below the battery hoppers, but not so far but that the stuff could be brought up to them on a gentle grade by the tramway. This uphill traction is understandable, but I think the other advantages would compensate for it. From the lower tunnel it would be possible to work the rich ground

the old shaft near the north boundary, where the best ore known on the property has been obtained, and, in driving south, the height of backs above the tunnel would be from 20 to 50 feet, permitting of a much larger output of material than the present adit.

In the workings it has been found that the dyke encloses occasional "horses" of the main granite, or else sends branches off into it, as the latter has now been found in more than one place with the quartz-porphyry on each side of it. The line of demarcation between the two is always quite distinct, there being no visible gradation from the one to the other as far as my observation went.

As natural drainage cannot be got for this mine without a very long adit, it will eventually require to be worked from a shaft, in which case a new battery site will probably be chosen near the shaft, the mines water raised by the pumps being used for the dressing plant. While the working results so far show that the average value of the stone is very low, I do not think that it is by any means hopeless to work it profitably; but, to do so, it will be necessary to deal with it in large quantities, and with the aid of every labour-saving contrivance. Only by a large expenditure to begin with can it be made to pay. On the other hand, the large quantity of stuff exposed makes it almost a certainty that if a margin of profit can be realized the mine will be steadily reproductive for a long period, and thus give better results to the investor than more brilliant yet more ephemeral mines.

Full Moon Extended 80 acre Section No. 1632M, and 40 acre Section No. 271-91 M. Nothing has been done on this property since I previously reported upon it, though an attempt was being made to pump out the shaft. This was not successful, owing to the boiler being too small to keep up the required head of steam for the Blake pump. There is some very fair tinstuff in this ground, and the owners were anxious to get into the shaft in order to take out 50 tons for a trial crushing. A few tons of very nice-looking stone had been scraped together from the surface trenches to help to make up the crushings, but no new work of any consequence had been done. The workings are on the same dyke as these of the M'Gough T.M. Company last mentioned, and show tin ore pretty freely in many places. A considerable quantity of ore could be got by driving the old tunnel from the Wyniford River south along the dyke: and this, though not very deep below surface, would test the superficial portions of the tin-ground pretty thoroughly; but I am inclined to think that it would be better to sink a shaft for drainage and hoisting, and work from it rather than from the adit. The dressing sheds would probably be best situated on the Wyniford River. A great deal more prospecting will have to be done before it can be estimated if this property is likely to be payable; and this will require considerable expense. There is every reason, however, for spending the money needed to test the ground, as the development so far as it has gone has given fair promise of success.

When I formerly visited the district I did not see any sign of the quartz-porphyry crossing the Wyniford River, and was told that it did not crop out in it; but if I had gone a little higher up the stream I should have seen it. It comes in a little above the adit, and extends right up to the "FallS", a distance of 12 or 15 chains; but in all this portion it seems

to be very dense and barren. On the north side of the river there is a very large development of the quartz-porphyry, in the Sections next to be described.

Sections 2292-87 M, and 405-91 M, these lie at the base of the small peak known as Mount Macmichael, the south-west corner peg of Section 405-92 M being right in the peak. A good deal of stripping of the surface soil has been done in Section 2292-87 M my Mr. Bealts, with fairly satisfactory returns of ore. The tin ore in this surface stuff is not waterworn, and is in a small black grains exactly the same as these found in the underlying quartz-porphyry. The lease are on surface is evidently derived simply from the weathering of the bedrock in situ. This has been still stripped by sluicing for a space of perhaps an acre and a half without exposing any of the main country granite. Parts of the quartz-porphyry are poor, but a little tin ore seems always to be present; and there is a considerable area, probably over a quarter of an acre in extent, which shows tin plentifully, and ought to be payable. The whole extent of the rich ground is not yet known, as the stripping has not gone far enough to bare it all. The tinstuff is exactly similar to that in the New Moon Company's mine. In Section 405-91 M very little work has yet been done, but some nice tin prospects have been obtained in alluvial ground from the three feet deep. In this there is a great deal of white angular quartz in large lumps, from which it is probable that there is a lode of some sort in the vicinity. Those two sections, generally known as Bealves', seem likely to be valuable, the prospects of tin being equal to those in the greater part of the New Moon and M'Gough workings; and, if the letter can be dealt with at a profit, it is probable the former will also pay.

Perennial - Section 1610-91 M, formerly 791-91 M, near the eastern boundary of this section a patch of rich tin-bearing quartz-porphyry about 12 yards square has been laid bare by slucing off the surface soil. Some 59 cwts. of tin ore was obtained from this small area. The tinstuff in the bedrock is soft and easily crushed, but would no doubt get harder in depth. The stuff is quite similar to that in the other stanniferous dykes, and if further prospecting should prove that there is a workable extent of it, this mine will have much the same prospect of success as the others in the district on the same class of stuff, Besides the

section named, the Perennial Company also own Sections 834- 91M and 79-91M. There appears to be a very large dyke of quartz-porphyry running south west from Mount Macmichael through these sections towards the Kent Company's ground: and there is much likelihood that when the surface is cleared other patches of payable tinstuff will be found in it. The presence of loose tin ore in unwaterworn crystals in the surface soil would be the readiest guide to the prospector in discovering these.

Mount Macmichael--Section 91-91M.-- It was in sluicing some surface stuff towards the west boundary of this section that the tin ore which was worked or the Perennial Company's adjoining section, 791-91M, was discovered. The quartz-porphyry formation extends through the Mount Macmichael Company's section into Beales', but very little has been done to test it except the above little bit of sluicing. A small tunnel has been begun near where the Perennial Company's discovery was made, but, after cutting an approach about a chain in length and driving 25 feet, work was abandoned. A little tin is to be seen in the approach and tunnel, but not payable. Lying as is does between the Perennial and Beales' discoveries, this seems a likely section and should be well prospected.

Kent--Sections 518-91M, 519-91M, 520-91M, 516-91M, 517-91M, 42-87M, 1145M, 670-91M, 667-91M, 668-91M,-- There is here an occurrence of tin ore quite similar to the foregoing ones. Several acres of ground have been stripped and sluiced, with fairly good yield of tin ore, and in the quartz-porphyry bedrock several patches have been found pretty richly impregnated with it. Three or four very shallow holes have been cut into some of these, and some very good tin stuff taken out. There seems a strong likelihood, from the extent of surface soil that has proved stanniferous, that there will be a correspondingly large area of tin-bearing rock below, but a lot of work will have to be done to prove this. The property ought to be prospected thoroughly, to if the stone should prove payable the working facilities obtainable are better than in the other properties that have yet been mentioned, there being a very steep fall from the west side of the holding to the Frome River.

Cream Creek. The sections formerly held by the Cream Creek Tin Mining Company, No Liability, have all been given up again by them, except 758-87M, on which the battery was situated. Part of the old mine has again been recently applied for by a party willing to give it another trial. The tin-bearing rock is the same as in the preceding cases-- a quartz-porphyry of variable composition impregnated with tin ore. It is possibly connected with the large dyke which seems to run all the way from Mount Macmichael to the Kent holding, but I cannot say that this is so for certain. The course of the workings in the Cream Creek mine is between N.E. and S.W., and N.N.N. and W.S.W., and if this is the course of the dyke it would run very much at right angles to the either one. The workings are situated on the slope of the range lying between the Wyniford and Froma Rivers, and extend nearly down to the latter, the battery being situated near the S.W. corner of Section 758-87M. The

reduction plant consists of 15 heads of stampers, and the dressing machinery of three pairs of spitzlutten, 4 pairs jiggers, 1 pair dressing jiggers, 3 18 ft. Kayser-buddles, 2 15 ft. single slime-tables, and 1 15 ft. double slime-table, all driven by a turbine and a 3 ft. Pelton wheel, with a water pressure of 94 feet. The crushing capacity of the plant was about 240 tons a week; it cost when completed about £6000. The machinery was well constructed and of a good type, being the same as is used so successfully at Mount Bischoff. It has since been sold to the Brookstead Tin Mining Company, and has, I understand, been removed by them. Mr. Thomas Oldham, who was mining manager of the company during its operations, informs me that 4375 tons of stone were crushed for a return of 21 tons of tin ore, worth, on the mine, £50 a ton, or £1050. There were also obtained five tons of tin ore from alluvial workings. The stone yielded .48 per cent. of black tin, and had a value of 4s. 9½d. per ton, which was not payable. I have been unable to obtain the cost of mining and milling in this instance. The stone crushed, however, was only a small fraction of the quantity broken out, probably tons being rejected for every one that went through the battery, and the mining costs per ton crushed would, therefore, be very high. The milling should have been done very cheaply, as the whole plant was worked by water-power, and only a very few hands were required. In all the company spent about £12,500, of which probably one-half was expended in mining works. Five principal faces have been opened along the dyke on the slope of the hill, and connected with the battery by means of a tramway. This, however, was not, as might have been expected, a self-acting grade, but an ordinary horse tramway, and as the different faces are at different heights a series of hoppers were required, necessitating four or five handlings of the rock from the highest faces before it got into the battery. The stuff from the highest face was carried a short distance in trucks and shot into a hopper, which lowered it to the level of the tramway from the next lower face; that coming from both these faces was then trucked along almost on the level for a few chains further and shot into a hopper, to be discharged at the next tramway line below, and so on. This was a very uneconomical way of working. The slope of the hill is very favourable for the construction of a self-acting grade, and it would have been an easy matter to arrange this, so that the rock from each face should go direct to the battery without handling on the way.

A very large quantity of stone has been mined and rejected, though most of it contains a little tin ore. I cannot help thinking that it would have been better to have been better to have put a great deal of this through the battery, so long as it would pay the bore cost of crushing and concentrating. The net financial result would be the same, but the output of the mine would be greatly larger, and if would have been possible to estimate the value of the rock in bulk and come to some conclusion as to whether it could be made to pay with a larger and cheaper battery. The best-looking ore is at the highest face, where there is some very nice tin in a softish talcose matrix, containing in addition a good deal of copper pyrites in parts. This face seems very likely to be rich enough to pay for working, and is therefore worth further trial.

Very fine specimens of rich tin stuff have been obtained

from various parts of the workings, but they were found very irregularly distributed, and a single blast was often sufficient to tear out all the payable rock in a face; nevertheless, there is a hope that portions will still be found rich enough and large enough to be profitably worked; and it appears to me a fair mining speculation to spend some money in prospecting for these. Systematic test ought to be made of all the rock exposed to ascertain if it could be worked successfully without selecting the ore. The working facilities being very good, a small percentage of tin might be made to pay, and I cannot regard the trial made by the late company as conclusive that the ground is worthless.

St. George's Section 1578-91M (formerly 375). This ground has been held for many years without any work being done on it, but lately a party of men have traced a run of nice heavy alluvial tin up from the boundary of the New Moon Company's sections into it, which they have been sluicing with payable results. This alluvial stuff is in a flat depression in the ground sloping down to the Full moon Creek, and is mostly pretty shallow, from one to three feet deep. The tin ore is much coarser than that found on the surface of the quartz-porphyry dykes, and resembles that got in the Full Moon Creek and on the Lottah ground, which was probably derived from lodes and veins. The country rock in this section appears to be all the main granite, not the stanniferous quartz-porphyry. The alluvial tin having the appearance of having come from a lode, search was made for this, and at about the line the hillsides, where the alluvial tin ore assesses to be found in the surface soil, one was found. It has been trenched across, and shows six feet in width of hard quartzose lode matter, striking N. 40° W. A little coarse tin ore has been found in some of the quartz. No sinking had been done when I saw it, but a few trenches had been put in across the line of it N.W. and S.N. from where it was struck. In these nothing was out but small loaders. I rather suspect that the apparent 6 ft. lode of quartz is only a flat vein, and that on sinking it would be out through very quickly; however, a little work would soon resolve the matter.

Puzzle-Sections 1173-91M, 1174-91M, 198-91M, 345-91M, 1515M, 343-91M, and 344091M, comprising 140 acres. This ground is taken up on a quartz-porphyry dyke which extends fromthe top of the Blue Tier range down to the Crystal Creek; it is connected with the dyke in the New Moon Company's Sections 907 and 908, had also with the large mens of quartz-porphyry extending westward from the Anchor Mine. A small branch of the Crystal Creek runs southward through the holding, and a good deal of ground sluicing has been done along the upper parts of this, the quartz-porphyry being bared for an area of about 3 chains long by one chain wide. The average depth of the surface soil stripped would be about two feet, though lower down it is 6 or 8 feet deep in parts. About 12 tons of tin ore have been raised from these workings. Most of the quartz-porphyry so far stripped is very barren, but there is a little tin frequently obtainable by crushing and wishing it, and in one place a large boulder was found with very good tin ore in it. In sluicing, some remarkably rich pieces of stone have been picked up, which must have come from the slope higher up. About two or three chains south of the north boundary of Section 1515M, and at a height of 700 feet above the Crystal Creek, the tin-bearing rock begins to be found in situ. A number of prospecting trenches have been sunk in a line running east and west for a distance of about five chains.

In all of these fair tin ore has been got, especially in those towards the west end of the line, where some of the rock must contain 8 or 10 per cent. of ore. The rich stone contains much green tale. In the eastern trenches there is a good deal of silicious gossan, some burnite, and a little wolfram, and it looks rather likely that there is a lode running east and west through the quartz-porphyry. The prospects of tin all along this line of trenches are so good that the work of opening the ground further ought most certainly to be gone as with all possible despatch. About a chain higher up the hill another east-and-west lode is met with, consisting of micaceous quartz containing much copper pyrites and a little tin ore. These loded may prove to be true lodes of considerable size and length, or they may be simply short bodies of quartz-porphyry much altered by infiltration of milica; they will have to be better laid open before laid open before their true nature is evident. Going still further north a few more holes are found in which tin-bearing porphyry has been exposed; one of these is about the centre of Section 198-91M, and shows a very white typical quartz-porphyry containing probably quite three per cent. of tin ore. Good tin is again seen in a hole close to the S.W. corner of Section 1173-91M, in quartz-porphyry, and also in another hole about four chains further north. Near the extreme north of the holding and right on top of the range there are two more holesshowing tin ore pretty freely in the rock. As mentioned in my former report, tin was found still further north again, in a shaft about 60 feet deep, in the old Ethel Company's ground and in several trenches; and it would appear likely that the dyke is stanniferous from here right through to the New Moon workings (M'Gough's section). So far as the Puzzle holding is concerned we may say that from the extreme north boundary of the property to two or three chains. south of the north boundary of Section 1515M, a distance of 26 chains, every hole that has been sunk into the quartz-porphyry has proved it to be tin-bearing, and probably rich enough to say for working. The ridge of the Blue Tier range at the northern-east boundary is 160 feet above Poimena township and 1100 feet above the Crystal Creek, and the ground slopes very steeply down to the latter. The upper part of the ground could be worked from either side of the range, but it would be best to work from the Crystal Creek side. Numerous open working faces could be cut into the tin-bearing rock, and the stuff from them sent down to a dressing-shed at the Crystal Creek by a self-acting tramway, at a very low cost for transport. A good battery site is obtainable at the Crystal Creek, and plenty of water for dressing purposes; I am not sure that there is water-power enough to drive a very large battery in the Crystal Creek: but, as the battery site would be over 1000 below the top of the range, it ought to be possible to bring in other streams as well, and so obtain the water supply required. Some 20 to 30 chains up the Crystal Creek, from its junction with the small creek running through the Puzzle workings, there are some falls in the stream; and above these falls there is a very good site for a dam which would impound a large quantity of water. From this dam to the battery site there are about 130 feet of fall. The Crystal Creek is a permanent stream and always contains a good deal of water, and in flood-time a very large volume. I do not think that there should be any extraordinary difficulty in getting sufficient water-power to work a large battery, if care were taken to conserve the rainfall as much as possible by constructing numerous small dams along the courses of the various small streams wherever the ground was favourable for doing so.

This property is very well situated for cheap working, and appears to me likely to be a very valuable one. It is very probable that when more of the quartz-porphyry formation has been laid bare by sluicing away the surface soil that payable stone will be found lower down the hill nearer the Crystal Creek than that now known. But even if this were not so, I think that a highly payable mine could be opened up, unless the present appearances are very deceptive. More trenching should be done on surface, in a systematic manner, so as to determine the area of good ground and the average value of the stone all over it; and as the hill is very steep, and testing by means of a tunnel consequently easy and inexpensive, an adit should be driven to try the quality of the dyke-stuff at a depth. A tunnel driven at the north boundary of Section 1515M would be about 400 feet below the top of the range. Should it demonstrate the existence of tin-bearing rock for a distance corresponding to the surface distribution there would be work for a century mine and mill it at the rate of 1000 tons a week. This gives some idea of the magnitude of these stanniferous formations at the Blue Tier, and of the immense importance to the Colony of ascertaining as soon as possible how to work them profitably. As pointed out in speaking of the New Moon mine, the first step is to prove how deep the tin-stuff extends, and to make sure that the quantities and values anticipated on the strength of the surface appearance are really present. If they will average over one-half per cent. of black tin, I feel certain that they can be made to pay.

Anchor. The workings of this Company are in the vicinity of the north-west angle of Section 893, being partly in this section, partly in 1211 A, and partly in 274. In addition to these sections the owners hold several others, amounting to about 300 acres in all, but I am not sure of the exact numbers of the sections. This mine was described in my former report, and I have now to add principally particulars of work done since. The battery has been very much improved by throwing out the old cumbrous dressing appliances and substituting Prue Vanners. There are 40 heads of stamps in the mill, but only 30 are in use, the remaining 10 being very much out of order. A stone-breaker has been placed between the tipping-frame and the feeding floor of the battery, and crushes the coarse lumps of rock before they go under the stampers. 15 heads of stampers are fed with stuff from the stone-breaker, and the other 15 are supplied with fine stuff from the mine trucks direct. No mechanical feeders are used, boys doing the work. The stone-breaker is awkwardly placed, and two men have often to be kept shovelling away the crushed material to keep it clear: this wants alteration. The battery crushes on an average about 170 tons a week, or barely one ton per head in 24 hours: this is a very poor result considering the case with which the rock is crushed: a good battery ought to put through three tons per head per day. The boxes are too wide, and consequently there is a very poor discharge. The whole battery wants extensive repairs. The stuff from the battery goes into three of the old separating tubs, which have been altered so as to work on the spitzlutten principle, though not nearly so effective as good spitzlutten. The sands are concentrated on four Prue Vanners and the slimes on two, and there is another one used for finally dressing the headings. The battery is driven by a large overshot water-wheel, 64 ft, in diameter and with 4 ft. breast: the vanners by a 4 ft. Pelton wheel under a pressure of 50 feet of water.

Since the present proprietors have had the mine and the Frue vanners have been put in, 12,307 tons of stone have been crushed for a yield of 134 tons of tin ore, realising a return of £6322. The rock therefore contained 1.09 per cent. of black tin, and was worth 10s. 3¾d. per ton. The average quantity crushed has been about 170 tons a week, or a total value of £87 6s. The average expenses per week for all wages on the mine and mill are from £50 to £52, to which have to be added the cost of supples, interest on cost of plant and sundry other expenses, an exact statement of which I have not been able to obtain. There is a profit of, probably, about £30 a week on the operations, and the cost of treatment per ton of rock is about 6s. 9d. This could be materially reduced by improving the mill and the methods of transporting the rock to it; the latter are very bad, the stuff having to be handled about six times. There are nine principal working faces and several smaller ones at different levels on the slope of the hillside, and the rock is shot from hopper to hopper, from the higher ones to the lower, in the same way as above described at Cream Creek. The hillside is steep, and all the faces could be easily connected with the battery by a self-acting grade. With improved methods of mining and milling I still think that the rock ought to be dealt with on this mine for not more than 4s. a ton.

The tin-bearing quartz-porphyry has now been exposed in this property over an area of about 8½ acres, and the full extent of the stanniferous groud has not yet been laid bare. The highest face is 185 feet above the battery hoppers, and the slope, of the ground most favourable for open quarrying. The different working faces are so distributed over the tin-bearing area that we can safely regard their produce as the average of the whole of the surface stuff. The superficial rock is softer, more clayey, and more easily crushed than the less decomposed rock lower down, and work has consequently been mainly confined to the easily mined stuff; but, so far as I could see, there was no perceptibly greater richness of the surface portions. Very little rock has been rejected, and we may fairly, I think, take the results of the crushings as showing what the whole rock mass would average. The old company got 154 tons of black tin from 18,427 tons of rock, and the present owners 134 tons from 12,307, the total produce to date being therefore 288 tons of black tin from 30,734 tons of stone, an average of .937 per cent.

As more work has been done on this mine than on any of the others at the Blue Tier, and as it has the advantages of a splendid situation for working , and of posessing water-power for driving the mill, it offers the best opportunity of any for the investment of the large capital required to work these stanniferous dykes to the best advantage. If the surface stuff is fairly representative of the general value of the dyke matter for a hundred or more feet in depth, there should be no doubt as to its being a highly payable concern and one of great magnitude. In order to prove the deposit throughly I should recommend the free use of a diamond drill; but a good test could also be made by driving into the hill from the lowest face and making cross-cuts from the tunnel. It appears to me that there is every reason to believe that the rock at a depth will be as good as that on surface; but this ought to be proved without any possibility of a mistake. Having proved it, a battery of 200 stamps might be put up with confidence.

On the south side of the Groom River and between the latter and the battery there is a considerable area of alluvial ground that is very likely to be payable. It has not been worked on account of want of outlet for tailings, and because some of it is deeper than the bed of the Groom River, but the use of a hydraulic elevator would surmount both these difficulties. The ground is well worth a trial, and would probably reward the company well for working it. 32

West Anchor. Very little has been done on this company's ground, which lies immediately west of the Anchor workings. A few trenches have been out which show that the quartz-porphyry exists in large quantity, but so far it has been poor, though very nice tin-ore was found in a patch in one of the trenches. A great deal more work has to be done before it can be known whether there is anything payable in the ground.

In section 383-91M belonging to this company a number of small parallel veins of quartz, very close together, are seen in the banks of the Groom River, composing a band about 12 feet wide in the main country granite. There are about 20 of these small veins in the 12 feet. The veins themselves are very small, ⅛ or ¼ of an inch in thickness only, but the granite on each side of them is often hardened and altered by infiltration of silica. A little tin-ore, a good deal of copper pyrites and a little wolfram are to be seen in the veins, but nothing payable. The course of the veins is about S. 65o W. The occurrence is very similar to another seen in the Great Eastern property, to be described below.

East Coast Bischoff Sections 69-91M, 252-91M, and 253-91M. A branch of the Anchor dyke of quartz-porphyry runs north-easterly into Section 69-91M, and in this a quartz lode has been discovered traversing it. A shaft 25 feet deep has been sunk on this, in the bottom of which the lode is composed of two feet in thickness of quartz, much iron-contained, and containing occasional largish flakes of mica. Strike, S. 35° W.; underlay, 1 in. 8 to N.W. On the foot-wall of the quartz vein there is about two feet in thickness of soft talcose clay containing a good deal of tin-ore. There appear to be several quartz veins in the country round the shaft, and some work might be done with advantage to develop these. About 15 feet from the surface the lode widens out to 6 feet of hard flinty quartz. I saw no tin-ore in this, but on surface there were a number of pieces of very rich ore in stone evidently from this part. It appeared to me very possible that the bulk of the lode lay to the westward of the bottom of the shaft, and that lower part of the latter has been sunk on a branch of the main vein. So little work has been done that no decided opinion can yet be formed as to this. Some very rich specimens have been exhibited as coming from this shaft, but very little tin could be seen in it anywhere at the time of my visit. Thirty-three feet below the mouth of the shaft a small adit has been driven S. 15° W., a distance of 31 yards, almost under the bottom of the shaft, and a few feet past it, and a small crosscut, 11 feet long, has been put in to the westward from the end of the adit. The country passed through in both shaft and adit is soft weathered quartz-porphyry, in parts a good deal stained with oxide of iron. I saw no tin in it, but a little is said to have been got here and there in driving. In the end of the drive there are some veins of quartz visible, but I saw no tin-ore in them, and they seem to me to be rather irregular strings then well-defined lode-masses. The quartz-porphyry being par excellence the tin-bearing rock of the

Blue Tier district, it is reasonable to suppose that lodes traversing it will be rich, and there is no doubt that these have been come rich pockets in this one, but so far as yet exposed it is far from payable. A great deal of harm has been done to the claim and to the district by wildly extravagent statements about the East Coast Bischoff lode, and it is to be hoped that those concerned in the mine will prevent a repitition of these, and do some more work underground to prove if there is anything payable there. About a chain south-west of the principal shaft there is a hole about 10 feet deep in nice-looking soft quartz-porphyry, but I could see no tin in it. Very little work has been done on this property, but it shows that the ground is worth prospecting.

Volturne. Sections 309-91M and 310-91M. A good deal of alluvial tin has been won from this property, which is on the main country granite. Two or three chains to the south west of the centre of Section 310-91M a large excavation has been sluiced out of the soft granite, and a small covered tail-race has been constructed. Several small soft veins traverse the granite and yield tin. One in particular is mostly soft talcose kaolin and mica and rubbly quartz, about 6 inches thick, lying pretty flat, its dip being about 15° to the westward. This is very rich in tin in parts. About two tons of tin ore in all were obtained fromthis place, but the vein got smaller as work progressed. A small shaft has been sunk in the bottom of the excavation, and in the hard granite brought up from it I noticed a small quartz vein with copper pyrites. The shaft was full of water, so could not be examined.

Crystal. On Section 202 and 203 a great deal of alluvial work has been done, and much tin been obtained, but not much is now being done. At the Crystal Creek there is still a good deal of flat ground to be worked, and an attempt is being made to do so with a small hydraulic elevator of a primitive design. There is not the least doubt that the low-lying ground could be easily worked by hydraulic elevators, and as high pressure water is easily obtainable there is no reason why it should not be tried.

Some six or seven chains from the eastern boundary of Section 203, towards the north-eastern angle, a lode has been discovered running north and south and underlying a little to the west. The soft outcrop has been worked by sluicing to a depth of often 12 or 15 feet, as deep, in fact, as it was possible to go with safety, for a length of 5 or 6 chains. The lode is said to have been up to 4 feet wide, and very rich: it must have been good to pay for the removal of so much barren granite along with it. Numbers of rich specimens are to be seen in the forkings from the sluicing. The bottom of the workings is now all full of rubbish and dirt from the sides, and the lode cannot be seen. In the north end it is visible, but has become hard and split up into veins. This lode, from what I have seen and can learn, is worth a mining trial: it can be easily driven on by a tunnel, as it strikes right up a steep hillside. The top of the workings on it are about 420 feet above the Crystal Creek.

Great Eastern 1051-91M and 2004-87M. Passing through the north-east corner of section 2004-87M, about three chains from the corner-peg, there is a group of small parallel quartz veins, striking N. 25° to 30° W. carrying a good deal of tin ore. The country rock is the main porphyritic granite. The formation, which might almost be called a stockwork, is from a chain to 30 yards in width where it has been laid bare, and has seen traced to the south east for about 15 chains. The veins are from one-eighth to one-fourth of an inch in width, rarely half an inch, and every few up to 1½ inches. The granite on each side of the quartz veins is often impregnated with silica and altered considerably. On the

surface the little veins, owing to their greater recistance to the weathering action of the atmosphere, stand out in small ridges up to half an inch high from the general surface of the granite. They are often very rich, but contain a good deal of wolfram as well as tin ore. Some years ago a shaft was sunk 25 feet on the east side of the formation, and a drive was put in to the west across it. This is now inaccessible; the veins are said to have been got as on surface. The rock is very hard, and I doubt very much if it could be made to pay. There are, without dispute, a large number of small rich veins, and the stanniferous ground is a good width, so that the rock could readily be broken out in quantity; still I am afraid so much barren rock would have to be treated that the rich veins would not pay for the whole. It is an interesting occurrence of tin ore. In order to ascertain the bulk value of the rock several trenches might be cut across the group of veins, and the stuff from these crushed and dressed. A test of 50 or 100 tons would afford data for an estimate of mining and milling costs, as well as of the value of the rock. Such work as has yet been done is in the south-east part of Section 1051-91M. On the line of the formation to the south-east, close alongside the main road, Messrs. Bak Hap obtained 19½ cwts. of tin ore from a patch of shallow alluvial ground about 100 feet long by 30 feet wide. A great many pieces of stone showing a small quartz vein flanked by dark altered granite were picked up in working, showing that the tin was probably derived from the group of veins.

Cambria 1510M, 482-91M, and 577-87M. These sections are situated on the edge of the Little Plains, and present several features of great interest. They are situated on a number of steep spurs and gullies towards the head of the the Waratah Creek. The lower-lying ground is all porphyritic granite, but the highest ports are overlaid by basalt of probably Tertiary age. Traces of a marine formation of age intermediate between these rocks are pretty common also, especially towards the western part of the property, loose boulders of the fesuiliferous sandstones and mudstones of the Lower Coal Measures (Permo-Carboniferous) being very abundant, also boulders of hard conglomerate. We must therefore expect to find in this vicinity the tin-bearing granite in places covered up by the younger sandstones and basalts. In the workings furthest to the north in Section 1510M close to the edge of the basalt the alluvial stuff shows a tendency to dip under the latter, and as no doubt, the outpouring of basalt completely altered the course of the streams then in existences, there is a considerable probability that deep loads may be found beneath it.

This locality has been a notable producer of tin in the past, and a fair amount is still being obtained. The present owners (Messrs. Cooper and party) have raised 30 tons, their prodecessors got 400 tons, and a large quantity was also obtained by Chinese tributers. A great deal of the tin ore is not much waterworn, and probably has not been carried far from the parent lodesl

There are two or more sets of lodes running through the property, one set running north and south, and another north west and south east, while some other veins have been laid bare which seem to run a course between those of the two main sets. It appears to be characteristic of the lodes that they consist not of one vein but of several parallel ones

lying close together and sometimes running into one another. The outcrops have been laid bare by sluicing the surface, and consist of talcose clayey matter mixed with rubbly micaceous quartz, and often contain very good tin. From the prospects I saw washed I should judge that the lodes must be payable to work or very nearly so, but of course a much more extended trial should be made before any value is attached to this opinion. The lodes are certainly good enough to be worth giving a working trial by sinking pitz on them at intervals, and taking out 50 tons or so for a bulk test.

Some years ago a beginning was made at working the lodes. A tunnel was driven 300 feet eastward from a gully close to the lodes, and cut both the north-and-south and the north-west and south-east lines. The farmer was driven on to the north for about 30 feet, and the latter for about 30 feet from each side of the adit. An intermediate lode was also cut and driven on a few feet. The tunnel is now very dilapidated and dirty, and a good view of the lodes is not obtainable, but still a good deal of tin ore can be seen. In the stone at the mouth of the tunnel tin is freely visible, yet the best part has been taken away. Chinese tributene sluiced a good deal of the stuff, and got some 26 cwts. of tin by this rough treatment. The tin ore is generally in large coarse crystals, and the best ore seems to be found in a talcose quartz. In all the Blue Tier lodes talc seems to be a very good matrix for tin.

The north and south line of lode has been traced about 30 chains. In section 577/87 it is seen in the old South Cambria shaft, said to be 120 feet deep. Fair prospects may be washed from the loose stuff lying about the shaft, and tin is also visible in the lode to the north of it, where it is cut through by two small creeks.

On the north-west and south-east lodes in Section 1510M an old prospecting tunnel was driven. This is now inaccessible, but a lot of very good ore from it is lying about the surface,. There would be no difficulty in getting together several tons of very good ore from the various workings that have been made. I do not know what was the reason why working the lodes was abandoned. The amount of work done was certainly not sufficient to give them a proper trial, and as far as can now be the quality of the ore obtained was very fiar indeed. The lodes are of fair width, from one to six or eight feet, and traced tin-bearing over considerable distances, and the shape of the ground is highly favourable for working means of tunnels. A good supply of water for milling is obtainable, and I rather think that water-power for driving machinery could be secured by making conservation dams. Altogether the property appears to be a very promising one, and well worth a thorough mining trial.

Liberator, 2521-87M, 346-91M, 237-91M, 3140-87M. These Sections are on the quartz-porphyry formation which is pretty continuous from the Anchor mine to here. About three chains south of the north-east corner of Section 2521-87M is the highest point of a small rounded hill from which the ground slopes gently to the northward, and rapidly south-ward to the Groom River. On the northward slope a good deal of surface sluicing has been done with payable results, the tin ore being the fine black crystalline sort characteristic of the quartz-porphyry formations. The rock bared by sluicing contains a little tin, but not enough to pay as far as I could see, but round the top of a small hill for about an acre in extent it

appears to be much richer. Right on the top of the hill a shaft eight feet deep has been sunk which contains tin ore pretty freely from top to bottom: two samples taken from it by Mr. Danvers Power, F.G.S., are said to have yielded 1.52 per cent. and 1.05 per cent. of metallic tin respectively: a sample taken by myself and washed on the spot gave a result of about the same value. Several other small holes have been made near the main one, and in all of these fair tip is to be got. The stuff is not rich, but should run about the same as the M'Gought portion of the New Moon Mine, probably from ½ to 1½ per cent, of black tin, over an area of at least an acre. As the alluvial stripping progresses and the surface of the rock is laid bare, it will be seen how much stanniferous rock there is, and a better idea of its value will be obtainable. If the other dykes on the Blue Tier should have payable this one also should be well worth working, and it would therefore be advisable for the owners to open it up sufficiently to prove its extent in area and depth. The latter could be most easily tested by diamond drills, but might also be effected by means of adits from the steep slope to the Groom River, which is 350 feet below the crown of the hill. An adit 1250 feet in length would be required to reach from the side of the river to a point below the shaft, but shallower adits could be put in higher up the hill with less length of driving. As all the face of the slope is quartz-porphyry they would be proving likely ground as they went along. A good battery site can be got down at the Groom River, and the stuff could very easily be sent down to it by a self-acting incline. There is always a good deal of water in the river, and I do not think there would be much trouble in getting water-power for a battery even of 50 or 60 heads. The working facilities being good, I therefore regard this as a very likely mine.

Waverley Lode, Weldborough. - Though not in the Blue Tier District, proper, this lode was visited by me immediately after leaving the latter, and was found to be similar in many respects to the Cambria veins. The granite country of the Blue Tier is continous right down to Weldborough, and, Geologically speaking, both places are the same formation. The behaviour of the Waverley Lode may therefore be a guide to what to expect of those at the Blue Tier. The Waverley mine is close to the township of Weldborough, and has been working alluvial ground for many years, about 1500 tons of tin having been obtained from it. In sluicing, several veins of quartz traversing the bedrock have been laide down, and some of these

contain tin; but the best lode-stuff yet found is on the hill side above the alluvial workings. The outcrop is about 230 feet above the main street of the township, and consists of a bunch of micaceous quartz veins, associated with Kaolin and talc, and carrying rich tin, and often a good deal of tourmaline. In all there appear to be some 10 or 12 feet in width of tin-bearing veins, with granite separating them, the veins themselves being 2 to 12 inches in width. The outcrop has been worked by sluicing to a depth of 15 or 20 feet for a distance of perhaps a chain. The veins run from N. 7° W. to N. 15° W., and appear to come together towards the south end. Here a short surface drive has been put in, following a vein of quartz and tourmaline 6 inches wide, carrying good tin. All the veins underlay westerly into the hill. The outcrop seems to have been largely composed of very soft lode matter, from which the tin was easily got by sluicing. The mean course of the bunch of veins is about N. 5° W. In order to cut the lode at a greater depth a tunnel has been driven about 82 feet below the outcrop a distance of 302 feet. This tunnel is not driven to come in right under the surface workings, but under a point some 200 feet south of them. The line of lode was laid out as S. 14° E., but if the mean bearing of the branching veins is taken, I think S. 5° or 7° E, would have been nearer the mark; the vein cut in the tunnel below is as seen below S. 7° E., and is probably parallel to the main belt of lodes. Owing to this bearing being taken the lode was expected to be cut at about 302 feet, but it seems to me to be more likely to be about 40 feet further in. The tunnel passed through soft decomposed granite for about 285 feet, and then struck the hard unaltered rock. At 290 ft. a small quartz lode, averaging 8 inches in thickness, was struck, carrying very rich tin, and a very little native copper. Strike N. 7° W., underlay about 1 in. 2 to the westward. The lode was driven on 4 feet to the south and 8 feet to the north, and become very small and poor in each end. The remaining 12 feet of the tunnel were made through very hard granite. I do not think the vein met with at 290 feet can be the main set of lodes or veins seen on surface, and think the adit should be continued further into the hill 40 or 50 feet at any rate.

General Remarks. The great problem for solution at the Blue Tier is how to profitably treat the large masses of low-grade quartz-porphyry rock existing in the Anchor, West Anchor, Liberator, Puzzle, New Moon, Full Moon Extended, Beales', Perennial, Kent, Cream Creek, and doubtless other mines. If these deposits continue to any depth of the same richness as on surface the wealth contained in them is enormous; and if means can be found of successfully winning the tin from them, the Blue Tier will be one of the greatest tin-producing districts of the world. Two things are therefore urgently required to be proved about them, first, that they are permanent to some depth, and, second, that they can be mined and milled for less than the value of the contained tin. Their behaviour in depth can be readily ascertained by diamond-drill boring or by shafts and adits; and in view of the immense importance of the question I would strongly urge the owners of the properties to lose no time in testing their ground. With regard to the possibility of mining and reducing the ore profitably, the average value of the rock is not yet well enough demonstrated to allow of at present saying whether it can or cannot be done; but supposing that it will average ½ per cent. of black tin of 70 per cent. metallic assay, I think that profits should be possible. With tin at £90 a ton, black tin of 70 per cent. metal is worth 6¾d. per lb., and ½ per cent. represents a value of 6s. 3½d. per ton of rock. With small

mills and very far from the best methods of handling the stuff 38
the Anchor Company have been able to reduce expenses to 6s. 9d. a ton, and the New Moon Company, in their M'Gough battery, to 6s. 10d. These results make me regard it as quite possible, with large mills and labour-saving appliances, to reduce the costs below the value of ½ per cent. rock very considerably. It is not easy to find an exactly parallel case to this one from which we might be able to learn what has been successfully done already under similar circumstances: the Red Face at Mount Bischoff cannot be cited, as the great bulk of the stuff is very soft and can be greatly reduced by sluicing before being sent to the battery: neither can we compare with the stockwork of Altenberg, in the Saxon Erzgebirge, which is similar in many respects to the Blue Tier tin deposits, and yields from ½ to ⅛ per cent. of tin ore, for European and Colonial costs of labour and appliances are very different. The most instructive example for comparison which I have been able to find is that of the copper mines in the Lake Superior district of North America. In these the ore is chiefly native copper and oxide of copper, and the treatment it receives is, first, crushing by rock-breakers and stamps; second, concentration by jiggers, buddles, slime-tables, Frue vanners, &c.; third, smelting and refining. This is exactly what has to be done to our tin-rock; and the smelting and refining of copper is rather more difficult than that of tin. The copper bearing "amygdaloid" and "conglomerate" rock has, moreover, to be mined, in most cases from great depths, up to no less than 3000 feet, and is as hard to mine and crush as our quartz-porphyry, or even harder, so that mining costs, where the stuff can be got by open quarrying, as in the Anchor, Liberator, and Puzzle mines, ought to be much lower here than there. Another point in our favour which should permit of costs being lower than in the Lake Superior mines is that good water for dressing, and perhaps for power, can be obtained by gravitation, whereas the Michigan mines have to pump up water for their dressing works. Costs of fuel, labour, and supplies are as far as I have been able to ascertain, as high at Lake Superior as here. There seems, therefore, every reason to believe that if our Blue Tier dykes were worked in the same extensive manner as the Michigan copper mines that they pay at even a less value per ton of rock. The following table gives some particulars of the work done by seven divided paying copper mines, taken from their published annual reports: the costs per ton of rock including all expenses of mining, milling, smelting, insurance, brokerage, storage, and office management, showing in fact the entire cost of treatment:-

Mine	Year	Tons of rock (2000 lbs) milled.	Refined Copper per ton produced.		Cost of t/ment per ton	
					s.	d.
Atlantic...	1889	278,700	13.27 lbs	or 0.66 per c.	6	4 1/32
Ditto...	1890	278.300	13.00 "	0.65 "	6	11 13/32
Ditto...	1891	297.000	12.30 "	0.615 "	6	5 7/32
Franklin...	1890	144,393	39.04 "	1.95 "	12	7 13/32
Ditto...	1891	135.758	31.56 "	1.58 "	11	5 7/32
Allouez....	1890	97,020	14.51 "	0.73 "	8	10 1/4
Kearsarge..	1890	60,619	26.87 "	1.34 "	9	5
Ditto...	1891	81,424	21.21 "	1.06 "	10	
Osceola....	1889	175,605	25.82 "	1.29 "	9	2 1/4
Ditto...	1890	188,561	28.08 "	1.44 "	9	11 13/32
Ditto...	1891	234,361	27.92 "	1.40 "	8	10 1/2
Quincy.....	1891	263,678	40.00 "	2.00 "	15	3
Tamarack...	1891	282,987	49.74 "	2.49 "	10	8 1/2

In the Allouex Mill in 1890 the cost of crushing and concentrating the rock came to 1s. 9½d. per ton. and in the Altantic mill to 1s. 2d. a ton. As showing the miners' wages, I note that in 1891 the 182 miners employed underground in the Quincy mine averaged earnings of $53.40 a month, or 8s. 6½d. a day. As showing the depths from which the rock is raised, the following particulars are of interest:-

The Tamarack No. 1 shaft is nearly 3000 feet deep and has 14 levels

The Tamarack No. 2 is nearly 3070 feet feet deep and has 15 levels

The Tamarack No. 3 shaft is 1300 feet deep, and has to 4250 feet to reach the lode.

The Tamarack No. 4 shaft is 1100 feet deep and has to 4480 feet to reach the lode.

The Tamarack Jr. No. 1 shaft cut the Calumet conglomerate, 10 ft. wide, at 2476 feet.

The Tamarack No. 2 shaft is down 2500 feet, and is calculated to strike the lode at 3000 feet.

The Kearsarge is raising rock from its 10th to 13th levels.
The Allouez No. 1 shaft is 1300 feet deep.
" No. 2 " 1800 "
" No. 3 " 1300 "

The Allouez mine has opened its 18th level.

The Red Jacket shaft of the Calumet and Hecla Mine is down 2425 feet, and is to be sunk to 3300 feet. Some of the workings of the Atlantic mine are at 2200.

The Centennial Mine expects to sink 3500 before it will cut any copper rock.

These depths are noted in order to show that these mines, with their remarkably cheap rates of treatment of the rock, are not favourably situated for working, but have the great disadvantage of having to wind rock and pump water from an immense depth. Superficial quarrying such as can be done at the Blue Tier, should be very much cheaper than such deep mining, and will no doubt yet be done for less than two shillings a ton.

These Michigan Copper Mines owe their success to the very large scale on which they are worked, and the immensely powerful machinery used, such as hoisting engines of 1200 h.p., pumping engines of 1200 h.p., and engines of 750 h.p. in the stamp mill. The crushing of the rocks is effected by means of what are known as Ball stamps, striking a blow of 40 foot-tons or more, and capable of crushing from 150 to 300 tons in 24 hours per head. The Calument and Hecla stamps average each about 230 tons in 24 hours. They are steam stamps, worked from an over head cylinder, to the piston of which the stamp stem is attached, and each head has a mortar to itself. Owing to the enormous power of the blow, the foundations have to be extremely strong and solid. I am not aware of these stamps having ever been tried for crushing tin-bearing rock, but can see no possible reason why they should not act as well as on the Copper rock, and attention is directed to them as a possible means of treating our Blue Tier stuff. It would be worth while to send a shipment of 500 tons to Lake Superior to be tried.

In comparing the costs of treatment at Lake Superior with our own it should be remembered that the former are calculated on the short ton of 2000 lbs., and, consequently, that we should add one-eighth to them. But even doing so, if the Atlantic Copper Company can raise stuff from a depth of 2000 feet and treat it for a total cost of 7s. 5d. a ton, using steam as motive power, I fail to see why we should not be able to quarry half per cent. tin-rock in Tasmania, and mill it by water-power, at a handsome profit.

Crushing Appliances. There has been a good deal of controversy among those interested in the Blue Tier district as to the best form of crushing-plant to be erected, some advocating stamps, some rolls, while other crushing appliances also have their own adherents. The subject is too wide for discussion here, but a few remarks may be made upon it. The stamp-battery and the Huntingdon mill have both been tried on the tin-bearing rock more or less successfully. The Huntingdon mill has proved itself a good machine for soft-stuff, but not very successful with hard quartz; most of the surface rock could, however, be very well treated by it. It is cheaper than a stamp-battery of equal crushing capacity, but is expensive in wear and tear, and a good deal of time is lost in effecting repairs. For a lot of the soft caleyey surface rock, however, it seems to me to be preferable to a stamp battery, while the latter is better for the harder and tougher portions. Of the stamp-batteries that have been put at work in the district, that at Cream Creek appears to have had the greatest crushing capacity, putting through $2^{2}/_{3}$ tons per head in 24 hours, as against two tons at the M'Gough mill, and less than one at the Anchor. None of these, however, are really first rate results, as, on the soft rock dealt with, each stamp-head should be equal to a performance of three tons in 24 hours, or even more. In order to secure this result the mortar or stamp-box ought to be specially made with low discharge, large screen surface, and very little space between the stamp-head and the sides of the box, the object being to get the crushed stuff cut of the way as fast as possible. A stamp-box made for treating auriferous quartz has more to do than one for tin ore, as a considerable part of the amalgamation is generally done inside it, and the shapes for the two purposes should be somewhat different. In our batteries a box made for gold quartz has been often used for tin ore crushing, and vice versa. In the same way there is not enough attention paid to the weight of the stamps, number of drops per minute, and longth of drop, all of which have a great deal to do with obtaining the maximum crushing work from a battery. Different sorts of stone require different treatment in these respects, and the best result can only be attained after numerous experiments. Another subject for careful and systematic experiments is the size of the holes in the gratings. In order to put through a large quantity of rock the screens should be as coarse as is compatible with saving the tin ore. These experiments are rarely gone about in a thorough and knowledge-seeking manner, the battery being set going in accordance with the judgment of the person in charge, and allowed to run on without attempting to find means of improving its performance. This is on a par with the prevalent system of making no regular tests of the tailings, leaving the batteries to ascertain what is being lost. The stamp-battery has the great advantage of simplicity, durability, and small cost and great case of repairs, and still holds its own against all competitors as an all-round useful crusher,

dealing equally well with hard and soft stone, clay, or anything else,. When proper precautions are taken to obtain its maximum performance its is probably the most suitable pulveriser for fine crushing of tin ores yet in the field. It should always be assisted by a stone-breaker, and fed automatically by a self-feeder.

For coarser crushing, rolls are generally better than stamps, and where progressive reduction of the stuff is desirable they are generally employed. For fine crushing high speed rolls are very successful with clean hard quartz, having very large capacity compared with a battery of the same cost; but where the material is clayey they are very liable to get choked and work badly. Much of the Blue Tier stuff is very clayey, and I do not think that fine crushing by rolls would work well. Coarser crushing could no doubt be successfully accomplished. A series of experiments with rolls might be made with great interest and advantage on the Blue Tier rock, for there is a probability that a great part of the tin in the surface rock could be set free by comparatively coarse crushing, it being sufficient to disintegrate the particles composing the rock, without crushing them to powder. For example, a piece of soft surface tinstuff (quartz-porphyry), from the Liberator mine was crushed by squeezing, not pounding, it in a mortar, and then washed off: it gave nearly all the tin ore it contained by this treatment. Half of the tailings was then washed off again without further grinding, and the other half was ground finely in a mortar and also panned off. The tin ore obtained was in each case about the same in amount, showing that the last grinding had practically no effect in freeing more tin. The experiment was instructive in another way: the tin ore, though very fine, was not slime, and was pretty easily saved in washing. If a rough crushing will liberate the ore there is no necessity for grinding it finely, and making a large quantity of slime tin. It seems possible that the soft stuff might be sufficiently disintegrated by passing it through rolls set pretty widely apart, to enable the bulk of the tin to be saved from it, and if the coarse uncrushed pieces were separated out by a trommel they might be crushed again more thoroughly. The harder rock found a little way below the surface could not, however, be dealt with in this way, and would have to be crushed in the ordinary fashion.

Rowley's mill, recently patented, is likely to be tried at the Blue Tier. From a trial of it in Launceston, at which I was present, it appeared to me likely to do very good work on the quartz-porphyry, especially the more clayey portions; and as it is cheap and a rapid pulveriser it seems likely to be very useful. It has not, however, been working long enough to afford to figures as to wear and tear and cost of repairs and working.

Very few, if any, of the numerous "disintegrators", "pulverisers", "pulverators", and ball-mills in the market are likely to be of use at the Blue Tier for tin-ore crushing, all having the fatal objection that they make too much slime. For the soft clayey rock, the "Dodge pulveriser", an iron churn of a sort, might be useful.

In my opinion, the choice of crushing machinery lies between Ball stamps, ordinary stamps, and mills of the Huntingdon type, with perhaps Rowley's mill, and under some circumstances, rolls. Of course stone-breakers should precede any of these crushers. I do not think progressive crushing will be of much use on account

of the general finances of the tin ore.

As regards dressing machinery I do not intend to make more than a few remarks. For coarse tin ore jiggers are the most sort of concentrators, and put through large quantities of stuff rapidly. For the sands the choice lies between buddles and revolving belt maches, like the Frue, Truimph, and Luhrig vanners: I should be inclined to favour the self-discharging belt machines. For the fine slimes the convex slime tables appear to me to do the best work. In order to have this classification into coarse and finer sands and slimes it will be necessary to use spitzlutten, with or without the addition of pyramidal settling-boxes (Spitz-kasten).

Power. In my 1889 Report I drew attention to the necessity of conserving the plentiful rainfall of the Blue Tier in order to get water-power. I have now only to re-iterate what was then said. The water-power need not necessarily be obtained close to a battery site, for with the perfection of transmission of energy by electrical means which has now been arrived at it is possible to utilize water-power several miles away. The falls on the George's River, and the numerous large streams which flow from the Blue Tier, may thus all be pressed into the service of the mines on the top of the range, and when this aspect of water-power is considered there can be no question as to the immense quantity of it available. If we are successful in treating the stanniferous dykes, a very extensive scheme of water conservation and utilization may be looked forward to.

Deep Adits. The mines on the top of the Blue Tier are hampered by want of water-power to drive their machinery, and are threatened with having to hoist all their rock to their batteries. The project of making long and deep tunnels from the Puzzle and Lottah mines under the New Moon and M'Gough dykes is therefore worth consideration. An adit one mile in length from the Puzzle ground would reach the north boundary of Section 907 of the New Moon Company's ground at a depth between 350 and 450 feet below the surface, and would be along ground stanniferous on surface all the way. The rock could be sent down by sheets to the tunnel level, and taken out to a battery in the valley of the Crystal Creek. At the same time the big conservation dams on the Wyniford slope of the range could be sources of high-pressure water for the other side. Another tunnel about the same length and equally deep could be taken in from the Lottah property, but would not have the same advantage of following the quartz-porphyry rock all the way. As drainage, mining, and supply of water-power would all be benefited by either of these deep adits they are worth keeping in mind.

Conclusion. In concluding this Report I have to express my conviction that the stanniferous dykes at the Blue Tier are of the very greatest importance to the Colony. They are of low value in tin, it is true, but of such immense size that a very small margin of profit can be made to mean an enormous sum in dividends, and, what is even more important, a steady and permanent industry employing a large number of men. To work them profitably will tax our engineering skill to the utmost, but will, I believe, be successfully done. At the risk of repeated re-iteration, however, I must point out that this opinion is founded on the supposition that the tinstuff remains to some depth of the same value as on surface,

which is not yet a proved fact. Even if it only lasts for 100 feet in depth, however, there would still be an immense body of crushing stuff. What has now to be done is clear; we must prove by boring and mining that the tin does or does not go down, for everything depends on this, then raise capital for working on a very large scale. If the tin does not last to a depth it will be a question whether the superficial tock will be sufficient in quantity to be worth treating in an extensive plant; but if it does go down, and averages anything over one half per cent. of black tin, then we may confidently look forward to the Blue Tier district becoming quite as famous as Mount Bischoff. I see no reason to fear that the tin will not last, and am therefore very sanguine as to the prospects of this field. 43

I have the honour to be,
Sir,
Your obedient Servant,

(signed) A. Montgomery , M.A.
Geological Surveyor.

The Secretary of Mines,
HOBART.